Section 6
Operation and Maintenance Program

This section of the 2001 Water System Plan (WSP) documents the operations program for Seattle Public Utilities (SPU). The section is designed to demonstrate satisfactory management of water system operations by SPU in accordance with WAC 246-290-100,-300,-310,-320, -440, -480, and –490, and WAC 246-292-020, -050 and –090. The section is divided into eleven sub-sections describing:

- Water system management and personnel;
- Certification requirements for key positions within the utility and SPU's commitment to ongoing training;
- Water system operation and control including major system components, routine system operation, program preventive maintenance, and equipment, supplies, and chemicals;
- Water quality comprehensive monitoring program;
- Emergency response program;
- Safety procedures for workplace hazards;
- Cross connection control program;
- Customer complaint response program;
- Record keeping and reporting procedures;
- Improvements in the systems operation and maintenance program; and,
- SPU's program for managing and evaluating its maintenance program.

6.1 Water System Management and Personnel

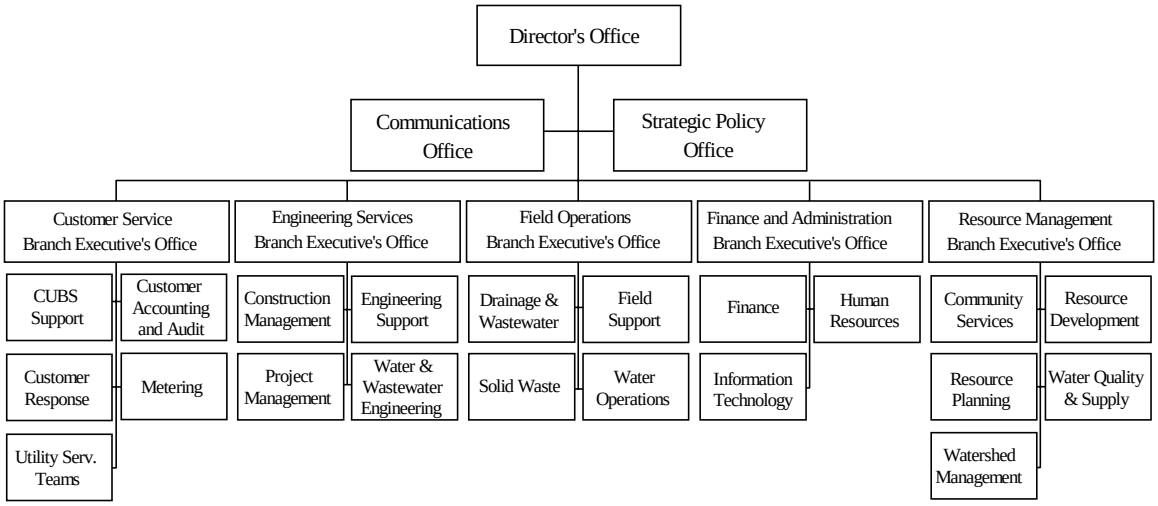
6.1.1 Overview

Since the preparation of the 1993 Water System Plan, the City of Seattle has re-organized how the City administers many of its utility functions. On January 1, 1997, the Engineering Department, the Drainage and Wastewater Utility, Solid Waste and Seattle Water were consolidated into one organization called "Seattle Public Utilities" (SPU). This new organization is now the entity responsible for the design, construction, operation, maintenance, quality control, and management of the water system under routine and emergency conditions.

Exhibit 6-1 shows the general organizational structure within SPU. SPU's operations can be separated into five "Branches" under the direction of the Director's Office. These Branches include:

- Customer Service
- Engineering Services
- Field Operations
- Finance and Administration
- Resource Management

Exhibit 6-1
General Organizational Structure of SPU



The responsibilities for the Director's Office and these Branches as they relate to the management of the water system are described below.

6.1.2 Director's Office

The Director's Office includes the Director of Seattle Public Utilities and the offices of Strategic Policy and Communications.

The Director is responsible for making sure the utility carries out the mission adopted for SPU. The Director has responsibilities typical of a water superintendent, such as developing budgetary requirements, assuring effective performance of the water system, and implementing City ordinances and utility policies regarding water service.

The Director's Office of Strategic Policy provides strategic guidance on regional issues and managing key initiatives for the water system, such as the Enhanced Capital Improvement Project.

The Communications Office disseminates information throughout the utility, across departments, and to the public. Responsibilities of the office include community relations, public information, purveyor communications, media relations, and employee communications.

6.1.3 Customer Service

The Customer Service Branch is responsible for providing support and assistance to all of SPU's customers receiving water supply, sewer, drainage, and solid waste and engineering services.

The Customer Response Division responds to customer complaints and needs. The Utility Service Team Division provides a variety of services, such as issuing water availability certificates, providing new water information and conducting water system inspections, for all residential accounts, commercial accounts and other major accounts. The division includes several water quality inspector positions which have Backflow Assembly Tester (BAT), Cross Connection Control Specialist (CCS), and Water Distribution Manager (WDM) certification requirements. This division is also responsible for implementing SPU's Cross Connection Control Program. Customer Service also has the Customer Accounting and Audit Division and the Metering Division.

6.1.4 Engineering Services

The Engineering Services Branch provides technical support for all utility functions and includes the Divisions of Construction Management, Engineering Support, Project Management, and Water and Wastewater Engineering.

6.1.5 Field Operations

Field operations provide service to customers 24-hours a day, 7 days a week.

The Field Operations Branch, with approximately 400 employees, is one of the largest and most diverse branches of SPU. The Branch is composed of four divisions. These divisions include Water Operations, Solid Waste Operations, Drainage and Wastewater, and Field Support. The Field Operations Branch provides service to the customers of SPU 24 hours a day, 365 days a year. The Water Operations Division operates, maintains, and improves the water transmission and distribution system to protect public safety, public health, and the environment.

The remaining divisions within this branch perform functions not related to the public water system.

6.1.6 Finance and Administration

The Finance and Administration Branch includes the Finance, Human Resources, and Information Technology Divisions and is responsible for the administration of all financial, personnel, and computer services within SPU.

The Finance Division is responsible for planning and administering the water system budget.

The Finance Division has responsibilities for administering and planning the budget for the water system. The Division includes the Accounting, Budget, Grants and Contracts, Rates and Economic Analysis, and Real Property Services Sections. The Accounting Section is responsible for accounting functions involving each of SPU's four revenue funds, including the water fund. The Budget Section provides support throughout SPU planning, budgeting, evaluating, and improving business processes. The Grants and Contracts Section provides support to the utility staff in procuring consultant contracts and obtaining and administering grants from outside sources. The Rates and Economic Analysis Section is responsible for annually evaluating and preparing recommendations on water rates. This section also analyzes annual water revenues based on expected water consumption and issues Quarterly Financial Reports for the Water Fund.

6.1.7 Resource Management

The Resource Management Branch plans and develops programs and capital improvement projects that improve water quality and supply; and has primary responsibility with the Water Operation Division in Field Operations for cost effective delivery of reliable, high quality, and aesthetically pleasing drinking water that provides maximum practical public health protection. Divisions within the Resource Management Branch include Community Services, Resource Development, Resource Planning, Water Quality and Supply, and Watershed Management.

Within the Community Services Division**,** the Resource Conservation Section develops and implements SPU's water conservation programs.

The Resource Development Division develops, manages, and oversees SPU's Capital Improvement Program and implements certain large departmental programs and projects that address infrastructure needs, environmental protection and enhancement, public health and safety, and regulatory compliance.

The Resource Planning Division provides long-range and environmental planning for SPU. This Division is responsible for the preparation of this Water System Plan and conducts environmental reviews of water supply planning and construction projects as required under both the Washington State and National Environmental Policy Acts (SEPA and NEPA).

The Water Quality and Supply Division is an operating unit with multiple functions.

The Water Quality and Supply Division is responsible for the development and implementation of system wide drinking water quality, water supply and major river anadromous fish management strategies and programs. This division operates the regional water supply from the OCC and is responsible for 17 water treatment plants and the Water Quality Laboratory. Recently, a SCADA Management Section was added to this division to implement the September, 1998 SCADA Strategies Plan. Staff throughout the division provide technical and engineering support to the utility's Capital Improvement Program and a variety of utility initiatives and studies.

These functions are performed through four organizational sections: Water Management, Regulatory Compliance, Water Supply and Treatment, and SCADA Management.

The Watershed Management Division ensures that Seattle's two surface water watersheds are protected and managed to provide a dependable raw water supply of the highest quality. In meeting this challenge, Watershed Management acts as an environmental steward of the South Fork Tolt River Watershed and the Cedar River Watershed through responsible management of water, land, forest, fish, wildlife, and cultural resources in the best public interest while protecting the source of the City's drinking water supply. The Division is responsible for administering the Watershed Protection Program described in Section 5. The Water Quality and Supply Division is responsible for implementing the Wellhead Protection Program.

6.2 Operator Certification

6.2.1 Introduction

Seattle places great emphasis on training and certification.

SPU is committed to meeting the requirements of the Water Works Operator Certification Program administered by the Washington State Department of Health (DOH) in conjunction with the Water and Wastewater Operator Certification Board of Examiners under the authority of Chapter 70.119 RCW and the comprehensive program regulations contained in Chapter 246-292 WAC. Under this program, water systems must employ certified operators to carry out various water system functions as part of treatment and distribution systems.

6.2.2 Certification Requirements

SPU is classified as a "Group A" public water system. The Group A classification requires that SPU have certified operators in charge of all active, daily, and technical operations of the water system. In meeting this requirement, SPU maintains certified personnel throughout the utility for a variety of water system operations. Classifications include Water

Distribution Manager Levels (WDM) I through IV, Cross Connection Control Specialists (CCS) and Backflow Assembly Tester (BAT) depending on the requirements of specific positions. Table 6-1 shows the current listing of mandatory water works operator positions for SPU as they relate to the organizational structure of the utility.

Table 6-1
Waterworks Personnel Certifications

Branch	Division	Position	Required Certification
Resource Management	Water Quality and Supply	Water Quality and Supply Director	WDM 4
		Water Supply and Treatment Manager	WDM 3
		Water Treatment Crew Chief	WDM 2
		Water Treatment and Supply Specialist	WDM 2
		Water Treatment Equipment Technician	WDM 2
		Senior Water Treatment Operator	WDM 2
		Water Treatment Operator	WDM 1
		Water System Supervisor	WDM 3
		Senior Water System Operator	WDM 2
		Water System Operator	WDM 1
Customer Service	Utility Service Teams	Chief Water Quality Inspector	WDM 3, CCS & BAT
		Senior Water Quality Inspector	WDM 2, CCS & BAT
		Water Quality Inspector	WDM 1
Field Operations	Water Operations	Water Operations Director	WDM 4
		Water Maintenance Supervisor	WDM 3
		Water Transmission Supervisor	WDM 3
		Water Pipe District Supervisor - North End Distribution	WDM 3
		Water Pipe District Supervisor - South End Distribution	WDM 3
		Water Pipe District Supervisor - All City Distribution	WDM 3

This list is updated on an annual basis for utility staff and submitted to DOH for their review. Appendix 6-A provides job descriptions for selected positions. SPU has worked successfully with DOH to change Seattle's Tolt and Landsburg source water treatment certifications from WDM to Water Treatment Plant Operator (WTPO) classifications.

Certified operators are either on-site or on call for all critical water system operations. SPU also ensures that certified operators are in charge of all segments of the water system as appropriate. Certified operators staff the Control Center and the three primary water treatment plants which are staffed 24 hours a day. Also, Water Pipe District Supervisors for the Water Operations Division of the Field Operations Branch maintain Water

Distribution Manager Level III certification for the "North End," "South End," and "All City" segments of distribution responsibility.

6.2.3 Training

All certified personnel for SPU renew their certificates on an annual basis and enhance their professional growth in the field by accumulating at least three college-related credits or continuing education units (CEUs) every three years. Personnel meet the CEU requirements through a combination of external and internal training opportunities. External opportunities include State-sponsored classes through the Washington Environmental Training Resource Center (WETRC). Examples of classes offered through this program include "Chlorination System Operation and Maintenance" and "Basic Electrical." Internally, SPU takes advantage of a wealth of expertise from a variety of professional staff to offer CEU approved classes for staff in the Water Quality and Supply Division of the Resource Management Branch. Examples of classes offered through this internal training include:

- Managing Seattle's Water Resources and Water Conservation
- Watershed and Resource Monitoring
- Water Chemistry
- Surface Water Treatment

6.3 System Operation and Control

SPU and Seattle City Light coordinate their activities on operations of water supply, hydroelectrical generation, in-stream flow, and flood control.

The purpose of this element of the Water System Plan is to provide a complete understanding of how SPU operates the water system. This general description begins with an overview of how SPU manages water supplies from available sources and balances drinking water demands with instream flow maintenance, hydroelectric power generation, and flood control needs. This overview is followed by a general description of how SPU operates the transmission and distribution system, including identification of major system components, routine system operation, preventive maintenance, and equipment supplies and chemical listings. It is important to note that the system operations and controls described in this section are not hard and fast rules but represent general management guidelines for operating the system.

6.3.1 Management of Water Supply Sources

As described in Section 1, SPU's water supply sources consist of surface diversions from the South Fork Tolt and Cedar Rivers and ground water withdrawals from the Highline Wellfield. Operation of these sources to meet water demands varies with the time of year, hydrologic conditions, fisheries concerns, environmental considerations, water quality, and level of water consumption.

Management of these water resources is the responsibility of SPU's Water Resource Manager, who is supported by Water Management Section staff responsible for analyzing hydrologic conditions, forecasting streamflow and reservoir conditions, and assessing fish needs. Data and input are also obtained from the Regulatory Compliance, Water Supply and Treatment, and Watershed Management Sections. State, federal and tribal resource agencies are also consulted throughout the year on water supply, flooding, and fishery conditions. Water Supply and Treatment and Transmission Staff are responsible for execution of the operations, except for those facilities operated by Seattle City Light.

6.3.2 Operation of Surface Water Sources

The surface water supply facilities on the South Fork Tolt and Cedar Rivers are operated primarily for water supply and instream flow maintenance but also provide hydroelectric power generation, and flood control. In general, the facilities are operated to meet different objectives depending on the time of year. Beginning in the fall, when the reservoirs are typically at their lowest elevation, SPU releases water from the reservoirs to meet instream flow and water supply needs. Although water system demands are tapering off from peak summer levels, instream flow needs begin to rise on the Cedar River to support chinook and sockeye salmon spawning.

At some time during October or November when fall rains return, inflows exceed reservoir releases and the reservoir levels begin to rise. Through the winter, however, SPU maintains capacity in the reservoirs to help reduce downstream flood peak flows.

In the spring, from about March to the beginning of June, the reservoirs are carefully managed to refill to normal maximum pool elevations so that the maximum amount of water is held in storage at the beginning of summer. Through the summer, natural inflow to the reservoirs decreases, and water system demands increase, so that reservoir levels decline towards their low fall levels.

At both the Cedar and Tolt facilities, hydroelectric power is generated throughout the year as a by-product of releases made for other purposes or to limit spills from the reservoirs.

To the extent feasible, Seattle controls releases to minimize scour of salmon redds.

Management of Cedar River Instream Flows. Instream flow releases to the Cedar River are dependent on minimum instream flow requirements, fisheries, and hydrologic conditions. Streamflows are not allowed to drop below minimum instream flow levels, but may be higher if natural flows are high, or if hydrologic conditions are favorable and such flows are believed to be beneficial to fisheries. To the extent possible, SPU controls releases to stay below flow levels that would lead

to scour of redds (egg nests) or result in steelhead or salmon spawning in areas vulnerable to dewatering when flows are lower.

The Instream Flow Agreement (IFA) which is part of the Cedar River Watershed Habitat Conservation Plan (HCP) changed instream flow requirements for the Cedar River. The IFA was developed over 7 years through a collaborative process involving federal, state, and tribal agencies. Both normal and critical minimum flow levels were revised, with the streamflow gage below Landsburg as the control point instead of the gage at Renton. Other flow requirements include the guarantee of additional supplemental flows or blocks of water at certain times of year, downramping limitations for certain flow ranges, and minimum flow releases from Masonry Dam. Interim criteria for "switching" from the higher normal levels to the lower critical levels are also specified. These criteria are based on reservoir levels and natural streamflow conditions. However, Seattle has committed to study alternative switching criteria with the intent of revising these criteria within four years of signing the HCP.

Under the HCP, management of many aspects of instream flows on the Cedar River are directed by the Cedar River Instream Flow Oversight Commission of which SPU is a member. Information used to set instream flow targets includes current and forecasted streamflows and reservoir storage; agreed upon minimum instream flows; fisheries field survey data such as redd location and fry emergence data; and other information relevant to making water management decisions.

Management of South Fork Tolt Instream Flows. Releases to the South Fork Tolt River are also dependent on instream flow requirements, hydrologic conditions, and an understanding of biological conditions. The South Fork Tolt River instream flow requirements are specified in the 1988 South Fork Tolt River Hydroelectric Project Settlement Agreement that was negotiated and committed to as part of the Federal Energy Regulatory Commission (FERC) licensing process for the hydroelectric power plant. This agreement specifies normal and critical minimum instream flow levels at a gage on the South Fork Tolt River near Carnation as well as criteria based on reservoir levels, streamflow conditions, and curtailment actions for "switching" from the higher normal levels to the lower critical levels. Minimum flows must also be provided immediately downstream of the dam. Other requirements, such as flow monitoring and limitations on the rate of flow changes, are also included in the 1988 Tolt Settlement Agreement.

The requirements have been specified for both the current system (with reservoir drawdown to elevation 1,730 feet) and the system with the Tolt Treatment Facility. With the Tolt Treatment Facility, the 1988 Tolt Settlement Agreement allows for reservoir drawdown to elevation 1,660

feet, although the reservoir will be normally limited to drawdowns to only 1,710 feet.

The amount of flood storage varies year-to-year based on snowpack, soil moisture, weather, and other factors.

Flood Storage. The amount of flood storage that is maintained at each reservoir varies from year to year based on snowpack, soil moisture, forecasted weather conditions, and other factors. Additionally, the surface impoundments are controlled during storm events to manage downstream flood peaks and for dam safety. SPU coordinates flood control operations with King County and municipalities located downstream of the dams such as the City of Renton on the Cedar River.

From November through March, Masonry Pool and Chester Morse Lake are generally held between elevation 1,546 and 1,553 to provide storage for flood control but may rise up to elevation 1,570 feet during major flood events. Hydropower generation and releases through the spill valve at Masonry Dam are used to control flows to the Cedar River. The service spillway gate is kept in the opened position during this time to provide passive outlet capacity when water levels rise above the spillway crest at elevation 1,557 feet. The emergency spillway gates at Masonry Dam can also be used for controlled releases and must be operated to prevent water from overtopping the dam when inflows equal or exceed 100-year flood levels.

Unlike Masonry Dam, the amount of control available at the South Fork Tolt Dam during a storm event is limited since the primary outlet is a morning glory spillway. The South Fork Tolt Reservoir is typically maintained at elevation 1,754 feet from November through February with the ring gate at the morning glory spillway in the lowered position (crest at elevation 1,762 feet). Releases during a storm event can be controlled to a certain extent by discharge through a valve to the South Fork Tolt River and through generation through the river return structure at the hydroelectric plant; the ring gate is generally not operated to control releases.

The starting date and rate of refill for each reservoir is determined by consideration of snowpack, soil moisture, potential runoff, reservoir water level, and other factors. Resident fish and wildlife species in the reservoirs are also considered, as reservoir levels and fluctuations can affect them. As an aid during refill operations, SPU uses a computer model which simulates watershed conditions and includes probabilistic forecasts of precipitation and runoff. At Chester Morse Lake, spring refill typically occurs between March and July, and the reservoir is considered full if the elevation of the lake on or around June 1 is between 1560 and 1,563 feet. For South Fork Tolt Reservoir, refill begins approximately in March and the ring gate is typically raised to elevation 1,765 feet in May to achieve maximum refill by early June. The ring gate is typically lowered in August when the reservoir level falls below the spillway crest.

6.3.3 Operation of Ground Water Source

When SPU operates the Highline Wellfield, it blends the water with Cedar River water to produce a consistent water

Highline Wellfield operations also vary seasonally. Withdrawals are made from the wellfield when water demand conditions indicate that this source is needed to augment surface water supplies during peak season. The wellfield is typically put into production in July but has been started as late as September. The wellfield is operated until ground water levels drop or the demand diminishes. Ground water modeling and field tests indicate that the wellfield can be used at full capacity for about four months before ground water levels become too low. In the winter, if ground water levels are low from previous withdrawals, the wellfield can be artificially recharged using water from the Cedar River. When an SPU groundwater source is operated, the source is treated and then blended with treated water from the Cedar River to ensure that all water quality targets are met. This approach provides water quality consistency to the limited and largely industrial customer base that can receive this water.

6.3.4 Key Factors in Operating Water-Supply Sources

The decision on the amount of water to be drawn from each of the sources at any point in time depends on several variables. These issues are discussed at weekly water-supply operations planning meetings. Key considerations typically used in decision making include the following:

- *Water demands by service zones including non-revenue water needs*. Estimates of municipal and industrial water demands are based on recent water consumption data and forecasted meteorological conditions.
- *Water supply availability*. Current conditions are based on streamflow and water level data collected on a regular basis. Forecasts of water supply quantities available from the surface supplies are based on a computer model which simulates runoff and watershed conditions from meteorological data and provides probabilistic forecasts of streamflows and reservoir levels. By adjusting deliveries from each of the sources based on hydrologic conditions, SPU can maximize the total amount of water delivered.
- *Instream Flow Requirements*. Operations of the storage and diversion facilities can affect fish and wildlife habitat and conditions. SPU works with State, Federal and Tribal Resource Managers to manage instream flows in a manner that protects aquatic resources.
- *Water quality requirements*. Certain supplies may not be available if raw water quality standards, such as turbidity limits at Landsburg Diversion, are not met.
- *Taste and odor concerns*. To address periodic taste and odor concerns in Lake Youngs and some open reservoirs, SPU can limit supply from

the Cedar River, temporarily bypass Lake Youngs, blend Landsburg water with Lake Youngs outlet water, remove Lake Youngs from service and clean distribution reservoirs. Long-term solutions to taste and odor concerns include ozonation of the Tolt and Cedar supplies and reservoir covers.

- *Treatment requirements*. Contact time requirements to meet DOH regulations typically limit the maximum amount of water that can be delivered from the Tolt (until filtration is on line) and Cedar River systems.
- *Treatment limitations*. In one situation, treatment equipment can constrain the minimum amount of water that can be delivered from a source. The chemical feed system for chlorine at the Lake Youngs Treatment Plant does not perform well for flows below about 45 MGD.
- *Transmission and distribution system capacity*. Deliveries from each source are limited by the capacity of the transmission and distribution system facilities. Special attention is used to limit pumping in the distribution system unless necessary to meet reliability and water quality objectives.
- *Facility outages*. Any planned system outages are coordinated with the Water Quality and Supply Division to ensure system reliability and water quality standards are maintained.

6.3.5 Transmission and Distribution Systems

Water System Operators in the Operations Control Center are responsible for implementing the management strategy. The dispatchers control the individual elements of the system, including intakes, transmission lines, pump stations, reservoirs, and control valves. Appendix 6-B provides a summary of these components, the role each plays in the overall system, and standard operating procedures. The summary of major water supply facilities addresses:

- Landsburg Diversion
- Lake Youngs Supply Lines #4 and #5
- Lake Youngs Bypass #5
- Lake Youngs
- The Tolt Regulating Basin
- Riverton Heights Wells #1 and #2
- The Boulevard Park Well

The summary for transmission lines cover all pipeline facilities including:

- Lake Youngs Tunnel
- The Control Works

- Cedar River Pipelines and Connections
- West Seattle Pipeline
- Maple Leaf Pipeline
- Cedar Eastside Supply Line
- Mercer Island Pipelines
- S. 160th Street Pipeline
- Des Moines Way Pipeline
- All Tolt Pipelines
- NE 195th Street Pipeline
- NE 115th Street Pipeline
- Haller Lake Pipeline

The summary for storage and supply facilities addresses all of the 16 reservoirs, 9 standpipes, 7 water tanks and 25 valves and regulators managed by SPU.

Appendix 6-C contains a listing of supplies and chemicals used by the water system at each facility and a list of chemical suppliers used by SPU.

6.3.6 Risk Management and Process Safety Management Plans for SPU's Water Treatment Plants

SPU is subject to the Risk Management Program Rule (RMPR) under Section 112(r) of the Clean Air Act, administered by the United States Environmental Protection Agency (EPA). The RMPR requires users of bulk quantities of toxic and flammable materials to develop Risk Management Plans for regulated facilities. SPU's three primary water treatment facilities at Tolt, Landsburg, and Lake Youngs trigger this regulation due to use and storage of chlorine gas above the 2,500-pound threshold quantity. SPU developed Risk Management Plans for these facilities and submitted them to EPA prior to the June 21, 1999, compliance deadline. Each Risk Management Plan is included in Appendix 6-D. One component of the Risk Management Plans is a fully functional Process Safety Management Program.

SPU is subject to both the Risk Management Program Rule and the Process Safety Management Standard.

SPU is subject to the Process Safety Management standard under WAC 296-67. This is a workplace safety regulation administered by the Washington Department of Labor and Industries. The regulation requires employers to take steps to analyze, manage, and mitigate safety risks to employees posed by the presence of bulk quantities of toxic and flammable materials in the workplace. The Tolt, Landsburg, and Lake Youngs water treatment plants trigger this regulation due to the presence of chlorine gas above the 1,500-pound threshold quantity. In-town treatment plants do not trigger this regulation because they are normally unoccupied facilities. SPU audited its Process Safety Management Program in the winter of 1998 and found several corrective actions that

were needed. A work plan to address these improvements are currently being implemented.

6.4 Comprehensive Water Quality Monitoring Plan

Providing public health protection is a primary concern in the operation and maintenance of a public drinking water system. Determining the adequacy of this protection is accomplished with a comprehensive monitoring program that covers the source of supply, treatment systems, distribution system, and customers' taps. Sampling requirements are established by the federal regulations under the Safe Drinking Water Act (SDWA) and in most cases adopted by the State. SPU conducts monitoring in accordance with the SDWA and DOH requirements in WAC 246-290.

A Comprehensive Monitoring Plan has been developed, and is included with this Water System Plan as Appendix 6-E. The monitoring plan addresses the following:

- Monitoring requirements under State and federal drinking water regulations;
- Future regulations, which are currently under development at the federal level;
- Non-regulatory monitoring, which SPU conducts for informational purposes and to assist in operating the water system;
- Sampling Procedures;
- Laboratory Information Management System (LIMS); and,
- All parameters, location and frequency of monitoring conducted by SPU. Monitoring locations include source, treatment, transmission and distribution system, and customer taps.

DOH has the authority to grant waivers for certain parameters, depending on vulnerability and previous sampling results. If a system is considered to have low vulnerability to contamination from a certain chemical or group of chemicals, the State may waive the requirements for sampling, or reduce the amount of samples required. The State issued waivers to SPU for Volatile Organic Chemicals (VOCs) and Synthetic Organic Chemicals (SOCs) in 1997 and 1998. There are also several area-wide waivers in effect for several of the SOCs. These waivers apply to all systems within the designated area.

SPU operates its own State-certified laboratory for a majority of the parameters monitored. This includes total coliform, fecal coliform, HPC, most inorganic chemicals, total trihalomethanes, lead, copper, and all SWTR parameters. Samples for VOCs, SOCs, asbestos, some inorganics,

SPU operates a new, state-of-the-art, certified laboratory that tests for the majority of the parameters required by DOH.

and some disinfection by-products are sent to other laboratories certified by the State or EPA for the analysis. In June 1999, SPU moved into a new state-of-the-art drinking water laboratory. SPU's laboratory will be expanding its capabilities in the future to include some of the parameters now sent to other labs.

Adjustments to monitoring are often required based on operational considerations, detection of organic chemicals, construction projects, or as required by the State based on a public health concern. SPU will work with the State to determine appropriate changes to the monitoring program to address any concerns that may arise.

SPU is currently conducting a review of its program for protecting water quality in the transmission and distribution systems. With enhanced treatment at the sources, water will enter the system with higher quality, and protecting this quality becomes increasingly important. The program, which includes both water quality monitoring and research, directly supports the objective of maintaining a high quality of water to the customers' tap. The review, being conducted with the aid of a consultant, will lead to recommendations for monitoring improvements and research to address current and near-term (through 2005) water quality objectives. The final product will be a Five Year Strategic Plan for Water Quality Monitoring and Research Needs.

6.5 Emergency Response Program

All Group A water systems are required to develop an Emergency Response Program under WAC 246-290. The intent of the Emergency Response Program is to address potential water shortage and water quality emergencies. The program is required to include a water system personnel emergency call-up list, notification procedures for water quality emergencies, a vulnerability analysis for the water system and contingency operational plans for the operating system when normal operating procedures are not available. In fulfilling these requirements, SPU has developed and is continuously refining an integrated Emergency Response Program that not only addresses individual system components but is also part of a coordinated disaster readiness and response program for the entire metropolitan region.

6.5.1 Disaster Readiness and Response Plan for the City of Seattle

In the event of a major emergency or disaster, the overall goals of the City of Seattle are to: 1) protect citizens and City employees; 2) save endangered property, infrastructure, and the environment; 3) restore public service operations; and 4) implement City-wide recovery efforts. This is laid out in the "Disaster Readiness and Response Plan" for the City of

Seattle (Seattle, 1999a) (Appendix 6-F). To meet the above goals, the plan outlines intergovernmental responsibilities and organizational relationships for City departments, including SPU and provides broad guidance to City managers and employees in the following areas:

Responding to disasters is a City-wide function.

- Mitigating vulnerability of known hazards;
- Maintaining readiness to cope with a major emergency or disaster;
- Managing interdepartmental cooperation and collective resources in a major emergency or disaster; and,
- Seeking outside assistance, when resource needs exceed local capabilities.

In addition to these guidelines, the Disaster Readiness and Response Plan is supported by nine "Annexes" for each Emergency Support Function that are part of the City's Emergency Operations Center. The purpose of these Annexes is to make the link between the Disaster Readiness and Response Plan and "on the ground" emergency response programs and operational contingency plans. Public Works is one of these annexes.

6.5.2 The Annex for Public Works Emergency Support Function

The Annex for the Public Works Emergency Support Function explains the details of emergency preparedness, mitigation, response and recovery in the event of a major emergency or disaster for the water system. The report identifies contingency operational plans for maintaining operation of water system components when normal operational procedures are not available. The Annex also explains the procedures for accessing emergency call-up lists which identify, in ranked order, water system personnel responsible for making decisions in emergency situations. Procedures for quickly notifying system customers, the public and local health jurisdictions and DOH of water quality emergencies are also documented in the Annex.

6.5.3 Vulnerability Analysis

The degree to which the water system might be adversely affected in various emergency situations is covered in the "Draft Hazard Identification and Vulnerability Analysis for the City of Seattle" (Seattle, 1999b). This document evaluates the potential vulnerability of the water system for water shortages and water quality emergencies under a variety of hazardous situations, including: aircraft accidents, civil disorder, conflagration, earthquakes, floods, hazardous materials incidents, landslides, snowstorms, tornadoes, tsunami and seiches, volcanic disruptions, drought induced water shortages, and windstorms. This draft

document is currently being revised to address threats of terrorism and other potential emergency situations.

6.6 Safety Procedures

Seattle has made worker safety a top priority.

SPU has made worker safety a top priority and the utility is committed to meeting all OSHA and WISHA regulations. The mission of SPU's Safety Program is to promote safe and healthy workplaces and to empower employees to take personal responsibility for job safety. SPU's Safety Principles are included in Appendix 6-G.

One of the cornerstones of SPU's Safety Program is the "Safety and Health Manual" (Seattle, 1998a). The purpose of this document is to provide a comprehensive description of all aspects involved in safety at the workplace for SPU. The Manual provides a detailed list of policies, programs and procedures for over 30 specific safety issues.

This list of policies, procedures, and programs is continuously being updated and revised as necessary and appropriate according to the Safety Review Process.

Another important component of SPU's Safety Program is the "Employee Safety and Health Handbook" (Seattle, 1998b). This document is distributed to all SPU employees. The purpose of the handbook is to provide easily accessible information to assist employees in performing work assignments in a safe and productive manner. The handbook includes summaries of all relevant Washington State and Federal safety and health requirements.

Potential workplace hazards for the water system (chlorine and other water treatment chemicals, heavy equipment, and asbestos-cement pipe) are identified in the Safety Checklist Job Hazard Analyses. Job Hazard Analyses (Appendix 6-H) have been prepared for nearly 40 specific activities.

6.7 Cross Connection Control Program

City of Seattle Ordinance #115660 (Appendix 6-I) provides the legal authority to administer and enforce the current cross connection control program.

The program consists of in-premise and premise isolation. With the April 1999 adoption of WAC 246-290-490, SPU is in the process of developing and implementing a joint program with King County Health Department for the best mix of both premise and in-premise isolation. This program will be authorized by the Director of SPU and will meet requirements of

WAC 246-290-490. Cross connections that cannot be eliminated will be properly protected with approved backflow assemblies.

6.7.1 Staff Responsibilities for Implementing the Cross-Connection Control Program

The cross connection control program is administered by Inspection Services, which is a part of the Utility Services Division of the Customer Service Branch of SPU. The responsibility for implementation lies with the Chief Water Quality Inspector who reports to the Inspection Service Manager. The Chief Inspector is required to be a certified Water Distribution Manager 3 (WDM), Washington State certified Backflow Assembly Tester (BAT), and a Cross Connection Control Specialist (CCS). The Senior Inspectors enforcing the Cross Connection Program are required to be Washington State certified WDM 2, BAT, and CCS. Inspection Services has an "in-house" training program, which encourages the other inspectors to continue their education, and work on higher certifications as WDM's and also cross connection control specialists.

6.7.2 Inspection, Notification, and Termination of Service

SPU is now in a pilot program with King County Health Department to develop a joint cross connection control program. SPU and King County Health Department conduct on-going meetings to ensure uniformity and compliance within the program. If there is an appeal from a customer concerning cross connections, the Inspection Service Manager, Chief Water Quality Inspector, and Chief Plumbing Inspector meet to determine the outcome of the appeal and an agreeable solution for the customer.

Inspections are prioritized from high hazard to low hazard facilities. The guideline for identifying high hazards is found in the State's definition of "high health cross connection hazard" which refers to a cross connection which could impair the quality of potable water and create an actual public health hazard through poisoning or spread of disease by sewage, industrial liquids, or waste.

Building information is received from the Business License Office, which maintains all business names and their type of business. When the list is compiled, it is split into categories and assigned to the Senior Utility Inspectors.

SPU has rigorous inspection procedures for all new water service connections.

The Inspection Services Section is responsible for inspecting all new water service installations. At the time of the inspection, information pertaining to cross connection requirements is posted at the job site. Plan review is also conducted, and backflow requirements are documented and public information letters pertaining to the facility are attached to the plans for distribution. After completion of the building, a walk through inspection

is conducted to outline any backflow requirements. Once all of the assemblies are in, the building is inspected again to ensure the proper installation and the proper assembly is used for the assessed degree of hazard.

SPU does not have a specific schedule for re-inspections at the present time. Any time they learn of work being done or change of occupancy, a survey is conducted to update the requirements for backflow protection within the facility.

SPU gives 90 days from the date of the initial inspection for the owner to install all required assemblies. After 60 days a reminder letter is sent out. If SPU has not received a response from the customer by the 90-day milestone, then SPU begins procedures to terminate the customer's water service.

6.7.3 Backflow Assemblies and Installation

SPU uses the Pacific Northwest Section (PNWS) Cross Connection Control Manual and USC Foundation for Cross Connection Control and Hydraulic Research Manual as references for determination of assembly application. SPU has developed public information letters describing different backflow protection measures required at specific facilities.

The above-mentioned manuals are also guidelines for assembly installation. SPU has brochures for the installation of Reduced Pressure Backflow Assemblies and Double Check Valve Assemblies that are handouts for customers. These brochures describe the proper installation that is acceptable to SPU.

All newly installed backflow assemblies must be on the DOH approved assembly list. Older, previously listed assemblies are still approved as long as they pass the annual performance test. Once they fail, they may not be repaired, but must be replaced with an assembly on the current approved list.

6.7.4 Backflow Assembly Testing Procedures

SPU requires that all backflow assemblies be tested on an annual basis and when installed, relocated, repaired, or replaced.

To test assemblies in the State of Washington, the tester must be a Washington State Certified Backflow Assembly Tester (BAT). To be on SPU's mailing list, SPU requires proof of current certification and an accuracy test on the test kit used.

SPU requires that all assemblies be tested when initially installed, relocated, repaired, or replaced and on an annual basis. SPU maintains a computer program to initiate monthly mailings for customers in order to notify them that it is time for the annual test on their backflow assembly(s). Customers are given 30 days to test the assembly and submit

the results to the utility. If SPU does not receive the test report within 45 days of the date of the initial letter, a second notice is sent certified mail. At this time the customer is fined $20 per assembly that has not been tested. The certified letter gives the customer 10 working days to have assemblies tested and reports submitted, or their water service is terminated.

6.7.5 Backflow Program Record System

The Inspection Services Unit keeps records related to the Cross-Connection Control Program in accordance with WAC 246-290-490. SPU's backflow program record system is fully computerized and contains two main components: "Backflow" and "Tracking." The Backflow component tracks all assemblies used by retail customers. This database includes information on owner/tenant, address, testing information, tester's name and certification number, assembly I.D. including make, model, size, serial number, location, and what hazard the assembly is protecting. The tracking program tracks plan reviews, site surveys, and second notices on building inspections.

6.7.6 Public Outreach

Presently, SPU uses information letters and installation brochures for public education and information. In the future, SPU may use a bill stuffer that introduces customers to the concept of cross connection and the control program. A brochure is currently in the works to address the six questions most typically asked by customers concerning cross connections.

6.8 Customer Complaint Response Program

6.8.1 Complaint Investigation and Follow-up

An SPU customer might occasionally receive water that is discolored, distasteful, or odorous. These are usually aesthetic problems resulting from corrosion or disturbance of sediment within water mains, but some may be indicative of a more serious problem, such as a cross connection. The Inspection Services Unit of the Utility Services Division investigates customer complaints about water quality. When these calls are received, the processing depends on whether a public health risk appears to be involved or not.

Complaints not indicative of a health risk are referred to a field inspector for follow-up. The inspector then contacts the customer within 24 hours of receiving the call. In most cases, the customers are called back during business hours on the same day the complaint was reported. The inspector determines the appropriate action to take and advises the customer. If

necessary, the inspector visits the property to perform an inspection, investigate site-specific conditions, and collect samples of the water for laboratory analysis. The inspector may request a special flush of the water mains in the area if determined to be required. The inspector follows up as necessary and notifies the customer of the findings.

SPU has rapid response and follow-up procedures for customer complaint calls.

All calls that could represent a public health risk are immediately referred to the Inspection Services Manager and/or the Chief Water Quality Inspector. If the call occurs off-hours, it is referred to the on-call Water Quality Inspector and the Water Operations Division duty supervisor. The duty supervisor will call out any staff necessary to identify the nature and distinguishing characteristics of the water. The field inspector will go to the site to evaluate the situation, collect samples for lab analysis and interview other residents in the area. If necessary, the field inspector will request assistance to isolate the affected portion or portions of the water distribution system. The duty supervisor will notify SPU staff and management and request help from the local health authorities as necessary. Customers will be notified about the situation via the news media, phone calls, or door to door as the situation demands. A field inspector will follow up with water samples and flushing until the situation has been resolved.

Less frequent than water quality complaints are customer calls about low pressure or flow. These can be caused by conditions in the utility's distribution system, but are more typically caused by conditions on the customer property. Old galvanized pipe that has been partially plugged by corrosion is a common cause. Appendix 6-K outlines the steps taken when a customer calls SPU about such problems, including the steps taken to identify the cause of the problem and facilitate a solution.

6.8.2 Customer Complaint Records

Customer complaints about water quality are recorded, and maintained within the service order system of SPU's new billing system. The Regulatory Compliance unit of the Water Quality Supply Division maintains records of water quality monitoring related to customer complaints. Records kept on file are as follows:

- Bacteriological and chemistry information is kept at the Water Quality Lab for a minimum of five years.
- Specific information on individual customers is kept with Customer Service records for a period of five years.

6.9 Record Keeping and Reporting

This section summarizes the procedures and tools used by SPU to record and report on data about water quantities and quality in the system. Some of this effort provides regulatory compliance data to DOH, while other data is gathered to aid decisions about operations, planning and design.

SPU is routinely updating its record keeping procedures to make efficient use of computerized databases.

In recent years, SPU has taken steps to increase the use of computerized databases for recording and reporting data. In addition to the efficiencies and capabilities inherent in a database, the electronic storage makes it practical to archive historical data indefinitely while having it easily accessible for analysis. SPU has traditionally retained data well beyond the minimum time periods specified in WAC 246-290-480, and the computerized systems will facilitate this.

The first implementation of a comprehensive quality and supply database was the Integrated Water Resource Management System (IWRMS), which came into use in 1995. This PC-based system replaced separate main-frame databases for supply and quality information. The new database included weather information from the watershed areas, water quantity information (e.g., reservoir levels and intake flows), and water quality data related to microbiology standards. The data generally represented daily values, such as totalized flow over 24 hours or the instantaneous value of a parameter at a certain time each day. The system also had the capability to generate many of the monthly reports required by DOH for compliance with the Total Coliform Rule (TCR) and Surface Water Treatment Rule (SWTR). Some of the less voluminous data, such as results of chemical monitoring, were not included in the database, but were maintained in separate spreadsheets. Some operational information, for example hourly values of distribution storage levels, was not included because of the effort that would be needed to input the data manually. This data continued to be recorded on paper by system operators or by chart recorders.

In 1996, SPU began using new SCADA-style hardware and software to automatically log system operations data received at the Operations Control Center at 15-second intervals. This greatly reduced the reliance on paper records for logging system data. However, IWRMS was not intended to handle this volume of information, and the data is currently archived on CD-ROMs.

A Laboratory Information Management System was recently installed at SPU's State-certified Water Quality Laboratory.

In 1999, a Laboratory Information Management System (LIMS) was installed at SPU's state-certified Water Quality Laboratory. This system provides improved tools for management of laboratory operations, such as scheduling workload, tracking samples, and reporting results. The system could not be easily linked to IWRMS, and has temporarily been used for storage and reporting of water quality data.

SPU is beginning the implementation of a data warehouse to provide the long-term storage of all operational data in one location along with the capabilities for trend analysis. This will allow the existing systems like IWRMS and LIMS to be optimized for data entry and operational decisions, including the short-term retention of data that may be provisional. Only confirmed data will be transferred to the data warehouse, probably on a weekly or monthly basis, depending on the type of data.

Sections within the Water Quality and Supply Division have responsibility for reporting and managing operational data. The Regulatory Compliance Section has the responsibility for water quality data and the submission of reports to DOH. The Supply and Treatment Section has responsibility for most supply-related data, with assistance from the Water Management and SCADA Sections.

6.10 Operation and Maintenance Improvements

Operation and maintenance improvements are discussed throughout this section.

6.11 Maintenance Management

SPU has recently implemented a comprehensive computerized program, called MAXIMO, for tracking all water system maintenance and operational activities. In addition to this maintenance program, the utility has recently completed an evaluation of its maintenance program through a benchmarking comparison to other western regional utilities.

6.11.1 MAXIMO

MAXIMO is a Computerized Maintenance Management System (CMMS) that can handle multiple aspects of maintenance and project work for the utility, including:

- Work order management;
- Planning and scheduling;
- Preventive maintenance programs;
- Asset management, including equipment history;
- Inventory control, purchasing and receiving;
- Material issues and returns for work orders; and,
- Integration with SPU's other information systems.

The MAXIMO system is made up of interconnected modules that facilitate the collection of data that is central to adequate maintenance programs. Operations and maintenance employees manage work orders for corrective maintenance, preventive maintenance, replacements,

upgrades and new construction. Via the work orders, asset histories are maintained, including repair frequencies and costs, equipment failures/problems/remedies, and equipment downtime. Work orders are managed to plan and schedule work, analyze overdue work, and track and manage backlogs.

Water Operations manages all labor involving water system facilities through MAXIMO, including emergency repairs, preventive maintenance, planned modifications and upgrades, new construction or installations, corrective maintenance, environmental response, and shops/fabrication work.

Most of MAXIMO's functions operate in real time. For example, work order status and information is provided in real time, as well as material issues/returns and inventory balances. Equipment failure reporting and work in progress are also reported in real time. Equipment records are updated as information is brought in from field. All labor transactions are entered when timecards are processed.

During 2000, the MAXIMO system will be extended to Water Treatment and Watershed Operations.

6.11.2 Benchmarking: Maintenance Program and Component Analysis

The Maintenance Program and Component Analysis used benchmarking work completed in 1998 to evaluate SPU's maintenance practices and component performance for the water system. The purpose of the analysis was to compare and contrast the performance and practices of SPU with that of other western regional water utilities. Components evaluated as part of this program included: meters, hydrants, pipes, pressure-reducing valves, line valves, pumps and drivers, and overall maintenance. Results of the analysis are presented in Appendix 6-J.